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गैर विनाशी विलेपन मोटाई परीक्षण की विशिष्टि

भाग 2 चुम्बकीय उपकरण

Indian Standard

SPECIFICATION FOR NON-DESTRUCTIVE COATING THICKNESS TESTING INSTRUMENTS

PART 2 MAGNETIC INSTRUMENTS

ICS 19.100; 17.040.30

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BUREAU OF INDIAN STANDARDS
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Industrial Process Measurements and Control Sectional Committee, ETD 18

FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Industrial Process Measurements and Control Sectional Committee had been approved by the Electrotechnical Division Council.

While Part 1 of this standard specifies the requirements of eddy current instruments for measurement of coating/plating thickness, this standard (Part 2) covers the use of magnetic instruments for measurement of thickness of the following types of coatings:

a) Non- magnetic coating on a magnetic substrate (basic metal), and

b) Electric-deposited nickel coatings on a magnetic and non-magnetic substrate.

The first variety of instruments measure either the magnetic attraction between a magnet and the basis metal, as influenced by the presence of the coating, or the reluctance of a magnetic-flux path passing through the coating and the basis metal.

The second variety of instruments measure with the magnetic attraction between a magnet and the coating-substrate combination, or the reluctance of a magnetic flux path passing through the coating and the basis metal.

While preparing this standard assistance has been taken from ASTM B499-75 'Draft Indian Standard for measurements of magnetic coating thickness by the method : Non-magnetic coatings on magnetic basis metals' and ASTM B530-75 'Measurement of coatings on magnetic and non-magnetic substrates'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SPECIFICATION FOR NON-DESTRUCTIVE COATING THICKNESS TESTING INSTRUMENTS

PART 2 MAGNETIC INSTRUMENTS

1 SCOPE

1.1 This standard (Part 2) covers the use of magnetic instruments for the non-destructive measurement of the thickness of a nonmagnetic coating on a magnetic basis metal.

1.2 This method also covers the use of magnetic instruments for the non-destructive measurement of the thickness of an electrodeposited nickel coating on either a magnetic or non-magnetic substrate.

2 REFERENCE

IS 12554 (Part 1) : 1988 'Specification for non-destructive coating thickness : Part 1 Eddy current instruments' is a necessary adjunct to this standard.

3 TERMINOLOGY

Relevant provisions of Part 1 of this standard shall apply.

4 CLASSIFICATION

4.1 As already explained these types of instruments may be divided in two classes:

Class A — Magnetic instruments for measurement of non-magnetic coatings on a magnetic substrate

Class B — Magnetic coatings on magnetic non-magnetic substrates

4.2 Class B instruments measure either the magnetic attraction between a magnet and the coating substrate combination, or the reluctance of a magnetic flux passing through the coating and the basis metal.

4.2.1 For this method, there are two types of coating substrate combinations that can be encountered. Type A, nickel coatings on a magnetic substrate, and Type B, nickel coatings on a non-magnetic substrate.

4.2.2 The effective measurings ranges of instruments using the principle of magnetic attraction are up to 50 µm for Type A coatings, and up to 25 µm for Type B coatings. For reluctance gauges, the effective ranges are much greater, and measurements up to 1 mm or more can be made on both types of coatings.

5 REQUIREMENTS

5.1 Factors affecting the accuracy of measurement by Class A instruments are given in Annex A.

5.2 Factors affecting the accuracy of measurement by Class B instruments are given in Annex B.

5.3 The instruments shall be robust in construction resistant to mechanical shocks, acids and solvents.

5.4 Instruments shall have the facility of one point measurement with a non-wearing probe and easy to read scale with retention of the reading.

5.5 The range and accuracy of instruments shall be as given in Table 1 when used at a temperature for - 20°C to 100°C.

5.6 The instruments shall be light in weight preferably less than 500 g.

5.7 Preferred dimensions of instruments are given:

Length	215 mm, *Max*
Width	55 mm, *Max*
Thickness	30 mm, *Max*

6 CALIBRATION OF INSTRUMENTS

6.1 Procedure for calibration of instruments for measuring thickness of non-magnetic coatings on magnetic substrate is given in Annex C.

6.1.1 Procedure for calibration of instruments for measuring thickness of electrodeposited nickel coatings on magnetic and non-magnetic substrate is given in Annex D.

7 ACCURACY

7.1 The Class A instrument, its calibration, and the operation shall be such that the coating thickness can be determined within ±10 percent of its true thickness. When measuring coating thickness of less than 5 m; this may only be possible by statistically evaluating replicate measurements.

7.2 The Class B instrument, its calibration, and its operation shall be such that the coating thickness can be determined with ±10 percent of its true thickness or ±1 m whichever is greater.

7.2.1 If it is not practical to meet the accuracy requirements, allowance shall be made for less reliable

Table 1 Technical Data for Magnetic Coating Thickness Tester

(*Clause* 5.5)

Application Type (1)	Range (2)	Tolerance[1] (3)	Minimum Area (4)	Minimum Curvature Radius of the Sample (5)	Minimum Base Thickness (6)
Electroplating and thin paint coating on steel	0-100 µm	1 µm or 5 percent of the reading	20 mm dia	5 mm convex 25 mm concave	0.5 mm
Paint on steel	0-1 000 µm	5 µm or 5 percent of the reading	30 mm dia	5 mm convex 25 mm concave	0.5 mm
Enamel plastic and rubber on steel	0.2-3 mm	5 percent of the reading	30 mm dia	15 mm convex 25 mm concave	1 mm
	0.5-5 mm	5 percent of the reading	50 mm dia	15 mm convex 25 mm concave	1 mm
	2.5-10 mm	5 percent of the reading	50 mm dia	15 mm convex 25 mm concave	2 mm
Electroplated nickel on non-ferrous substrate	0-50 µm	1 µm + 5 percent of the reading	15 mm dia	5 mm convex 25 mm concave	—
	0-100 µm	1 µm + 5 percent of the reading	15 mm dia	5 mm convex 25 mm concave	—
Electroplated nickel on steel	0-70 µm	1 µm + 5 percent of the reading	20 mm dia	10 mm convex 25 mm concave	0.5 mm

[1] Thickness standards supplied by the manufacturers.

measurements, and the contacting parties must agree on their acceptability of this test method and of the less reliable measurements.

7.3 Nickel Phosphorus Alloys

7.3.1 Autocatalytic deposited nickel-phosphorus alloys containing more than 8 percent phosphorus are sufficiently non-magnetic to be measured in accordance with Annex C, for measurement of coating thicknesses by the magnetic method or nonmagnetic coating on magnetic basis metals, if deposited on a magnetic substrate.

7.3.2 Since a subsequent heat treatment will increase the magnetism of these coatings, it is necessary that, when measuring heat treated coatings containing more than 8 percent phosphorus, the instrument be calibrated against heat-treated standards having a known coating thickness, or equivalent calibration foils.

7.3.3 Nickel-phosphorus alloys with less than 8 percent phosphorus are much more magnetic, but since their magnetic properties will depend on the phosphorus content, the measurement of electroless-nickel coating containing less than 8 percent phosphorus by a magnetic method is not recommended.

8 MARKING

Relevant provision of Part 1 of this standard shall apply.

9 PACKING

Under consideration.

ANNEX A

(*Clauses* 5.1 *and* C-1.2)

FACTORS AFFECTING THE MEASURING ACCURACY

A-1 The following factors affect the accuracy of a coating thickness measurement.

A-1.1 Coating Thickness

Inherent to the method is a measuring uncertainty that, for thin coatings, is constant and independent of the coating thickness, for thicknesses greater than about 25 m, this uncertainty is proportional to the coating thickness.

A-1.1.1 *Magnetic Properties of the Basis Metal*

Magnetic thickness measurements are affected by variations in the magnetic properties of the basis metal. (for all practical purposes, magnetic variations in low-carbon steel can be considered to be insignificant).

A-1.1.2 *Basis Metal Thickness*

For each instrument, there is a critical thickness of the basis metal above which the measurements will not be affected by an increase in the thickness of the basis metal. Since it depends on the instrument probe (*see* Note) and the nature of the basis metal its value should be determined experimentally if not supplied by the manufacturer.

NOTE — In this method 'instrument probe' will also include the term 'magnet'.

A-1.1.3 *Edge Effects*

The method is sensitive to abrupt changes in the surface contour of the test specimen. Therefore, measurements made to near an edge or inside corner will not be valid unless the instrument is specifically calibrated for such a measurement. The effect may extend to about 20 mm from the discontinuity, depending on the instrument.

A-1.1.4 *Curvature*

The measurements are affected by the curvature of the test specimen. The influence of curvature varies considerably with the make and type of instrument and always becomes more pronounced as the radius of curvature decreases. Instruments with two-pole probe as the radius of curvature decreases. Instruments with two pole probes may also produce different readings if the poles are aligned in planes parallel or perpendicular to the axis of a cylindrical surface. A similar effect can occur with a single-pole probe in the tip is unevenly-worn.

A-1.1.5 *Surface Roughness*

Measurements are influenced by the surface topography of the basis metal and the coating. Therefore, it is necessary, on a rough or scratched surface, to make a greater number of measurements at different positions to obtain a mean value that is representative of the average coating thickness. If the basis metal is rough, it may also be necessary to check the zero of the instrument at several positions on a portion of the uncoated, rough, basis metal.

A-1.1.6 *Direction of Mechanical Working of the Basis Metal*

Measurements made by an instrument having a two-pole probe or an unevenly worn single-pole probe may be influenced by the direction in which the magnetic basic metal has been subjected to mechanical working (such as rolling), the reading changing with the orientation of the probe on the surface.

A-1.1.7 *Residual Magnetism*

Residual magnetism in the basis metal affects the measurements made by instruments which employ a stationary magnetic field, its influence on measurements made by reluctance instruments employing an alternating magnetic field is much smaller.

A-1.1.8 *Stray Magnetic Fields*

Strong stray magnetic fields, such as are produced by various types of electrical equipment, can seriously interfere with the operation of magnetic thickness instruments.

A-1.1.9 *Foreign Particles*

Magnetic instruments of all types, such as are produced by various types of electrical equipment, can seriously interfere with the operation of magnetic thickness instruments.

A-1.1.10 *Conductivity of Coating*

Some magnetic instruments work at frequencies between 200 and 2 000 Hz. At these frequencies, eddy current produced in thick, highly conductive coating may interfere with the reading.

A-1.1.11 *Pressure*

Instruments readings are sensitive to the pressure with which the probe is applied to the test specimen.

A-1.1.12 *Probe Orientation*

Instruments using the principle of magnetic attraction may be sensitive to the orientation of the magnetic in relation to the field of gravity of the earth. Thus, the operation of an instrument in a horizontal or upside down position may have different calibration, or may be impossible.

ANNEX B

(*Clause* 5.2)

FACTORS AFFECTING THE ACCURACY OF MEASUREMENT

B-1 FACTORS AFFECTING THE MEASURING ACCURACY

B-1.1 Coating Thickness

Inherent in the method is measuring uncertainty that for thin coatings, is constant and independent of the coating thickness greater than about 50 µm this uncertainty is proportional to the coating thickness.

B-1.2 Magnetic Properties of the Basis Metal (Type A Coating only)

Magnetic thickness measurements are affected by variations in the magnetic properties of the basis metal. For practical purposes, magnetic variations among low carbon steels can be considered to be insignificant.

B-1.3 Basis Metal Thickness (Type A Coatings only)

For each instrument, there is a critical thickness of the basis metal above which the measurements will not be affected by an increase in that basis metal, its value should be determined experimentally, if it is not supplied by the manufacturer.

NOTE — The term 'instrument probe' also includes the term 'magnet'.

B-1.4 Edge Effect

The method is sensitive to abrupt changes in the surface contour of the test specimen. Therefore, measurements made too near an edge or inside corner will not be valid, unless the instrument is specially calibrated for such a measurement. This also applied to measurement made on geometrically limited areas, such as narrow conductors on printed circuit boards.

B-1.5 Curvature

Measurements are affected by the curvature of the test specimen. The influence of curvature varies considerably with the make and type of instrument, but always becomes more pronounced as the radius of curvature decreases. Instruments with two-pole probes may also produce different readings, depending on whether the poles are aligned in planes parallel or perpendicular to the axis of a cylindrical surface. A similar effect can occur with a single-pole probe, if the tip is unevenly worn.

B-1.6 Surface Roughness

B-1.6.1 Measurements are influenced by the surface topography of the substrate and the coating, and a rough or scratched surface will be given individual instrument readings that will vary from point to point. In this case, it is necessary to make many readings at different positions to obtain a mean value that is representative of the average coating thickness.

B-1.6.2 If the basis metal is magnetic and rough, it may also be necessary to check the zero of the instrument at several positions on a sample of the uncoated rough substrate.

B-1.6.3 If the roughness of the substrate surface is small, relative to the coating thickness, its effect will probably be negligible.

B-1.7 Direction of Mechanical Working of the Basis Metal (Type A Coating only)

Measurements made by an instrument having a two-pole probe or an unevenly worn single-pole probe may be influenced by the direction in which the magnetic basis has been subjected to mechanical working, such as rolling. The reading may change with the orientation of the probe on the surface.

B-1.8 Residual Magnetism (Type A Coatings only)

Residual magnetism in the basis metal affects the measurements made by instruments that employ a stationary magnetic field. Its influence on measurements made by reluctance instruments employing an alternating magnetic field is much smaller.

B-1.9 Stray Magnetic Field

Strong stray magnetic fields, such as those produced by various types of electrical equipment, can seriously interfere with the operation of magnetic thickness instruments.

B-1.10 Foreign Particles

The probes of magnetic instruments of all types must make physical contact with the test surface and are, therefore, sensitive to foreign material that prevents intimate contact between the probe and the coating surface.

B-1.11 Magnetic Properties of the Coating

Magnetic thickness measurements are affected by variations in the magnetic properties of the coating. These properties depend on the conditions under which the deposit is produced, the type and composition of the coating, and its stress. The magnetic properties of multiple layer nickel coatings will also depend on the relative thickness of each of the layers.

B-1.11.1 A heat treatment at 400°C for 30 min will equalize the magnetic permeability of dull (Watts) nickel coatings of the same composition. Bright nickel deposits may or may not have the same magnetic properties after heat treatment.

B-1.12 Pressure

Instrument readings are senitive to the pressure with which the probe is applied to the test specimen. Errors that sometimes are encountered with the use of manual probes can be avoided by employing spring-loaded probes that exert a relatively constant pressure.

B-1.13 Probe Orientation

Instrument readings may be sensitive to the orientation of the magnet in relation to the field of gravity of the earth. Thus, the operation of an instrument in a horizontal or upside down position may require a different calibration, or may be impossible.

ANNEX C

(*Clauses* 6.1 *and* 7.3.1)

CALIBRATION AND MEASURE PROCEDURE

C-1 CALIBRATION OF INSTRUMENTS

C-1.1 Before use, the instrument shall be calibrated in accordance with the instruction of the manufacturer employing suitable thickness standards.

C-1.2 During use, the calibration shall be checked at frequent intervals, at least once a day. Attention shall be given to the factors listed in Annex A and to the procedures described.

C-1.3 Calibration standards of known thickness are available either as shims or foils or as coated specimens.

C-1.3.1 *Calibration Foils*

NOTE — In the following paragraphs, the use of word 'foil' will imply a non-magnetic metallic or non-metallic foil or shim.

C-1.3.1.1 Because of difficulty of ensuring adequate contact, foils are generally not recommended for the calibration of instruments based on the principle of magnetic attraction but they are suitable in some circumstances provided the necessary precautions are taken. They can normally be used for the calibration of other types of instruments.

C-1.3.1.2 Foils are advantageous for calibration on curved surfaces and are more readily available than coated standards. To prevent measurement errors it is necessary to ensure that intimate contact is established between foil and substrate. Resilient foils should be avoided if possible. Calibration foils are subject to indentation and should, therefore, be replaced frequently.

C-1.4 Coated Standards

These calibration standards consist of coatings of known, uniform thickness permanently bonded to the substrate material.

C-1.5 The basis metal of the calibration standards shall have magnetic properties similar to those of the basis metal of the coated test specimen. To confirm their suitability, a comparison of the readings obtained with the basis metal of the bare standard and that of the test specimen is recommended.

C-1.6 In some cases the calibration of the instrument should be checked by rotating the probe in increments of 90°.

C-1.7 The basis metal thickness for the test and the calibration shall be the same if the critical thickness, defined in **2.1.3**, is not exceeded. It is often possible to back up the basis metal of the standard or of the test specimen with a sufficient thickness of similar material to make the readings independent of the basis metal thickness.

C-1.8 If the curvature of the coating to the measured is such as to preclude calibration on a flat surface, the curvature of the coated standard, or of the substrate on which the calibration foil is placed, shall be the same.

C-2 MEASURING PROCEDURE

C-2.1 Operate each instrument in accordance with the instructions of the manufacturer.

C-2.2 Check the calibration of the instrument at the test site each time the instrument is put into service and at frequent intervals during use to assure proper performance.

C-2.3 Observe the following precautions.

C-2.3.1 *Basis-Metal Thickness*

Check whether the basis-metal thickness exceeds the critical thickness, if not, either use the back-up method mentioned in **3.5** or make sure that the calibration has been made on a standard having the same thickness and magnetic properties as the test specimen.

C-2.3.2 *Edge Effects*

Do not make readings close to an edge, hole, inside corner, etc, of a specimen unless the validity of the calibration for such a measurement has been demonstrated.

C-2.3.3 *Curvature*

Do not make readings on a curved surface of a specimen unless the validity of the calibration for such a measurement has been demonstrated.

C-2.3.4 *Number of Readings*

Because of normal instrument variability, it is necessary to make several readings at each position. Local variations in coating thickness may also require that a number of measurements be made in any given area, this applies particularly when the surface is rough. As instruments of the attractive force type are sensitive to vibrations, reject readings that are obviously too high.

C-2.3.5 *Direction of Mechanical Working*

If the direction of mechanical working has a pronounced effect on the reading, make the measurement on the test specimen with the probe in the same orientation as that used during calibration. If this is impossible, make four measurements in various orientations by rotating the probe in increments of 90°.

C-2.3.6 *Residual Magnetism*

When residual magnetism is present in the basis metal, when using two-pole instruments employing a stationary magnetic field made measurements in two orientations differing by 180°. With single-pole instruments employing a stationary magnetic field, it may be necessary to demagnetize the test specimen to get valid results, and this may also be advisable with two-pole instruments.

C-2.3.7 *Surface-Cleanliness*

Before making measurements, clean any foreign matter such as dirt, grease, and corrosion products from the surface without removing any coating material. Avoid any areas having visible defects, such as welding or soldering flux, acid drops, or oxide when making measurements.

C-2.3.8 *Lead Coatings*

The magnet of an instrument of the attractive force type may stick to lead and lead allow coatings. Apply a very thin film or oil to improve the reproducibility or readings and correct the measurement for the thickness of the oil film. The correction may be determined by measuring the coating thickness of a non-sticking coating of appropriate thickness with and without the oil film and taking the difference between the two measurements. Do not use this procedure with other coatings.

C-2.3.9 *Techniques*

The readings obtained may depend on the technique of the operator. For example, the pressure applied to a probe or the rate of applying a balancing force a magnet, will vary from one individual to another. Reduce same operator who will make the measurement or by using constant-pressure probe.

C-2.3.10 *Positioning of Probe*

In general, place the instrument probe perpendicular to the specimen surface at the point of measurement. For some instruments of the attractive force type, this is essential. With some instruments, however, it is desirable to tilt the probe slightly and select the angle of inclination giving the maximum reading. If, on a smooth surface, the readings obtained vary substantially with the angle of inclination, it is probable that the probe is worn and needs to be replace. If a magnet instrument is to be used in a horizontal or upside-down position, calibrate it for that position.

ANNEX D

(*Clause* 6.1.1)

CALIBRATION AND MEASURING PROCEDURE FOR INSTRUMENTS FOR NICKEL COATINGS ON MAGNETIC AND NON-MAGNETIC SUBSTRATES

D-1 CALIBRATION OF INSTRUMENTS

D-1.1 Before use, each instrument shall be calibrated in accordance with the instructions of the manufacturer, employing suitable thickness standards. During use, the calibration shall be checked at regular intervals, at least once a day. Attention shall be given to the factors listed in Annex B and to the procedures in Annex D.

D-1.2 The calibration standards shall be coated standards obtained by electroplating nickel adherently onto a substrate.

D-1.3 The substrate and the coating of the standard shall have the same magnetic properties as those of the test specimen (*see* **2.2**, **2.3**, **2.11** and **2.11.1**).

D-1.3.1 To confirm the similarity of the magnetic properties of the substrate to those of the standard, a comparison of the readings obtained with the bare basis metal of the standard and that of the test specimen is recommended.

D-1.3.2 In the same manner, the similarity of the magnetic properties of the coating of the test specimen to that of the standard can be established by varifying with the coulometric or microscopical method that the thickness reading obtained on the test specimen by means of the properly calibrated instrument corresponds to the actual thickness determined by one or both of the above methods.

D-1.4 Where indicated, the calibration of the instrument should be checked by rotating the probe in increments of 90° (*see* **2.7** and **2.8**).

D-1.5 For Type A coatings the basis metal thickness for the test and the calibration shall be the same if the critical thickness, defined in **2.3** is not exceeded. When possible, back-up the basis metal of the standard, or the test specimen, with a sufficient thickness of similar material to make the readings independent of the basis-metal thickness.

D-1.6 If the curvature of the coating to be measured is such as to preclude calibration on a flat surface, the curvature of the coated standard shall be the same as that of the test specimen.

D-2 PROCEDURE

D-2.1 Operate each instrument in accordance with the instructions of the manufacturer. Give appropriate attention to the factors listed in Annex B.

D-2.2 Check the calibration of the instrument at the test site each time the instrument is put into service, and at regular intervals during use, to assure proper performance.

D-2.3 Observe the following precautions.

D-2.3.1 *Basis Metal Thickness* (*Type A Coatings only*)

Check whether the basis metal thickness exceeds the critical thickness. If not, either use the back-up method of **3.5** or make sure that the calibration has been made on a standard having the same thickness and magnetic properties as the test specimen.

D-2.3.2 *Edge Effects*

Do not make readings close to an edge, hole, inside corner, etc, of a specimen, unless the validity of the calibration for such a measurement has been demonstrated.

D-2.3.3 *Curvature*

Do not make readings on a curved surface of a specimen, unless the validity of the calibration for such a measurement has been demonstrated.

D-2.3.4 *Number of Readings*

D-2.3.4.1 Because of normal instrument variability, it is necessary to make several readings at each position. Local variations in coating thickness may also require that a number of measurements be made in any given area; this applies particularly to a rough surface.

D-2.3.4.2 Instrument of the attractive force type are senstitive to vibrations, and readings that are obviously erroneous should be rejected.

D-2.3.5 *Directions of Mechanical Working* (*Type A Coating only*)

If the direction of mechanical working has a pronounced effect on the reading make the measurement on the test specimen with the probe in the same orientation as that used during calibration. If this is impossible, make four measurements as various orientations by rotating the probe in increments of 90°.

D-2.3.6 *Residual Magnetism (Type A Coatings only)*

When residual magnetism is present in the basis metal, it is necessary when using instruments employing a stationary magnetic field, to make measurements in two orientations differing get valid results (*see* **2.7** and **2.8**).

D-2.3.7 *Surface Cleanliness*

Before making measurements, clean any foreign matter such as dirt, grease, and corrosion products from the surface without removing any coating material.

D-2.3.8 *Techniques*

The readings obtained may depend on the techniques of the operator. For example, the pressure applied to a probe or the rate of applying a balancing force to a magnet will vary from one individual to another. Such effects can be reduced or minimized either by having the instrument calibrated by the same operator who will make the measurement, or by using constant pressure probes.

D-2.3.9 *Positioning of the Probe*

D-2.3.9.1 In general, place the instrument probe perpendicular to the specimen surface at the point of measurement. For some instruments of the attractive force type, this is essential. With some instruments, however, it is desirable to tilt the probe slightly and select the angle of inclination giving the minimum reading.

D-2.3.9.2 If, on a smooth surface, the readings obtained vary substantially with the angle of inclination, it is probable that the probe is worn and needs upside-down position, calibrate it for that position.

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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